Brominated dioxins in plastics – Emissions during fires

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Brominated flame retardants (BFRs), such as polybrominated diphenyl ethers (PBDEs), tetrabromobisphenol A (TBBPA) and hexabromocyclododecane (HBCD), are added to polymers, textiles and other materials to reduce their flammability. Their main applications are in plastic housings, circuit boards and cables of electronic equipment, and in polyurethane foams of furniture. Although the use of some BFRs is restricted today, others are still being used in large quantities, and there are also continuously new types of BFRs introduced on the market. Furthermore, BFRs in old materials and equipment will continue to circulate in our society a long time to come.

The BFRs are in themselves toxic and constitute a risk as they may leak from the materials during production, use and end-of-life treatment. However, there is also a concern that other hazardous brominated compounds may accompany the BFRs. It has thus been shown that many of these materials also contain substantial amounts of polybrominated dioxins and furans (PBDD/Fs), which is because PBDD/Fs often are present as impurities in technical BFR mixtures and because PBDD/Fs may be formed as BFR-containing materials are processed into refined products. In addition, it has been observed that some BFRs (e.g. PBDEs) may be photolytically transformed into PBDD/Fs as flame retarded plastics are exposed to natural sunlight.

Like the BFRs, the PBDD/Fs may leak from the materials during their normal usage. However, this leakage will most likely increase if the materials are subjected to some kind of destructive or thermal process, such as fragmentation or combustion. Such processes may be generated deliberately, as during material recycling, or unintentionally, as during accidental fires. Furthermore, processes that involve high temperatures may not only lead to a release of the inherent PBDD/Fs, but also to the formation of new PBDD/Fs, that will enhance the emissions even further.

In this presentation we show examples of levels and patterns of PBDD/Fs and BFRs that may be found in plastics related to electronic equipment. We also show examples of the quantities and types of PBDD/Fs and BFRs that are emitted as the plastics are heated at different temperatures and conditions. Emission data are shown for all from controlled lab-scale experiments, semi-controlled pilot-scale experiments to an uncontrolled accidental fire. For the latter, the levels and patterns found in the environment after the fire are also presented.